TGRS Overview

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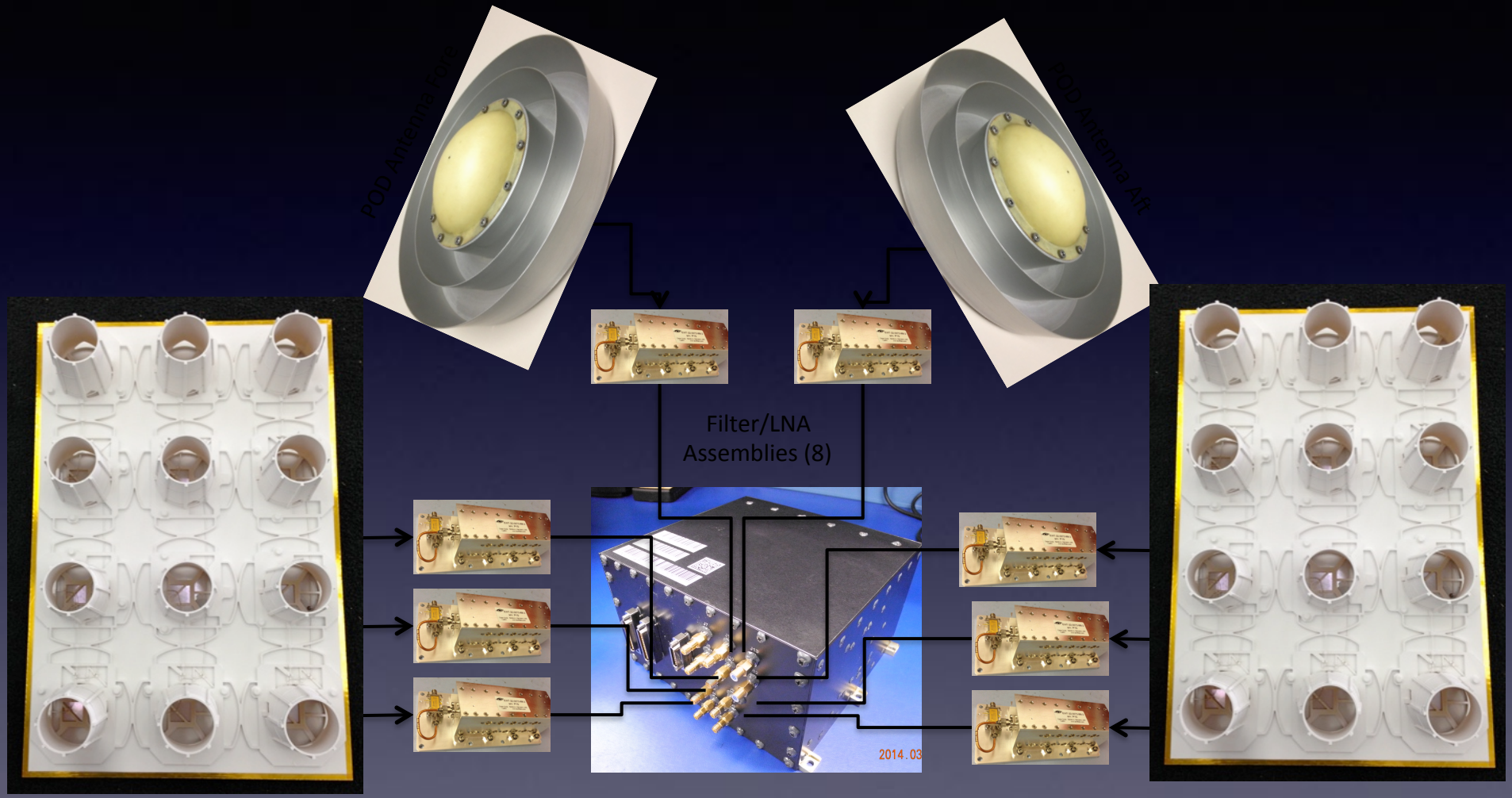
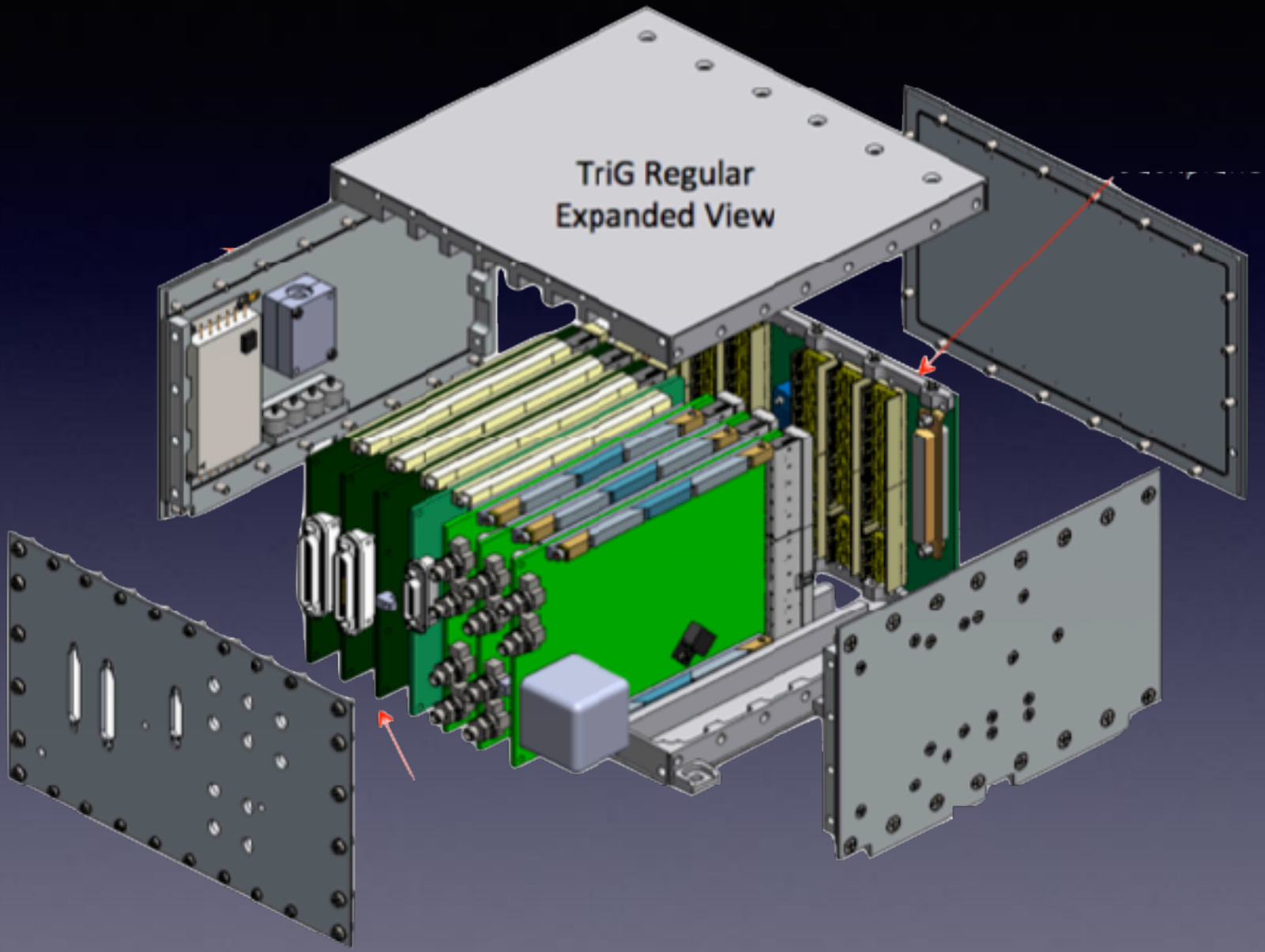
Topics

- TGRS C2 Configuration
- NavP Processing
- SciP Processing
- Issues

TGRS Refresher



TGRS Refresher
TriG



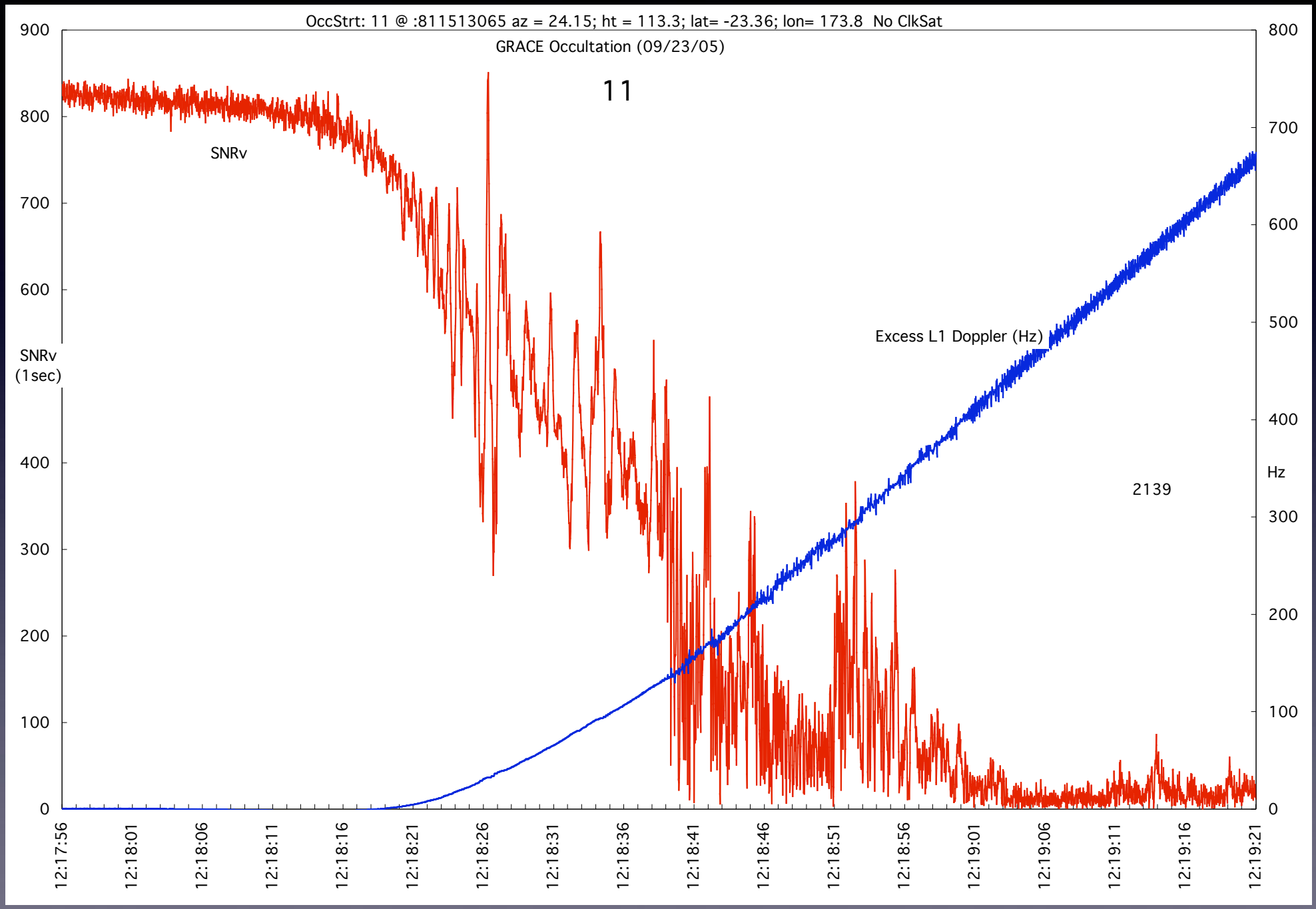
TGRS / C-2 NavP Processing

- The NavP is primarily intended to provide real-time positioning info for scheduling of science observations
- GPS satellites are continuously tracked via one or both fore/aft navigation antennas
- Synchronization data is sent from NavP to SciP
- NavP acts as interface for all data passing to/from spacecraft C&DH

TGRS / C-2 SciP Processing

- The SciP is primarily intended to schedule and record atmospheric occultations from ~100km to ~0km altitude
- Both GPS and GLONASS satellites are processed in order to observe over 1000 occultation profiles per day
- To overcome very weak SNR, the SciP uses digital beam forming for 3x improvement in precision relative to COSMIC-1
- GLONASS ionospheric occultations and arcs are also processed by the SciP

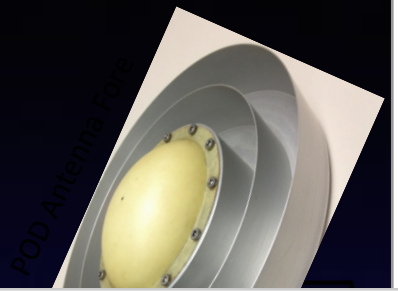
TGRS Processing

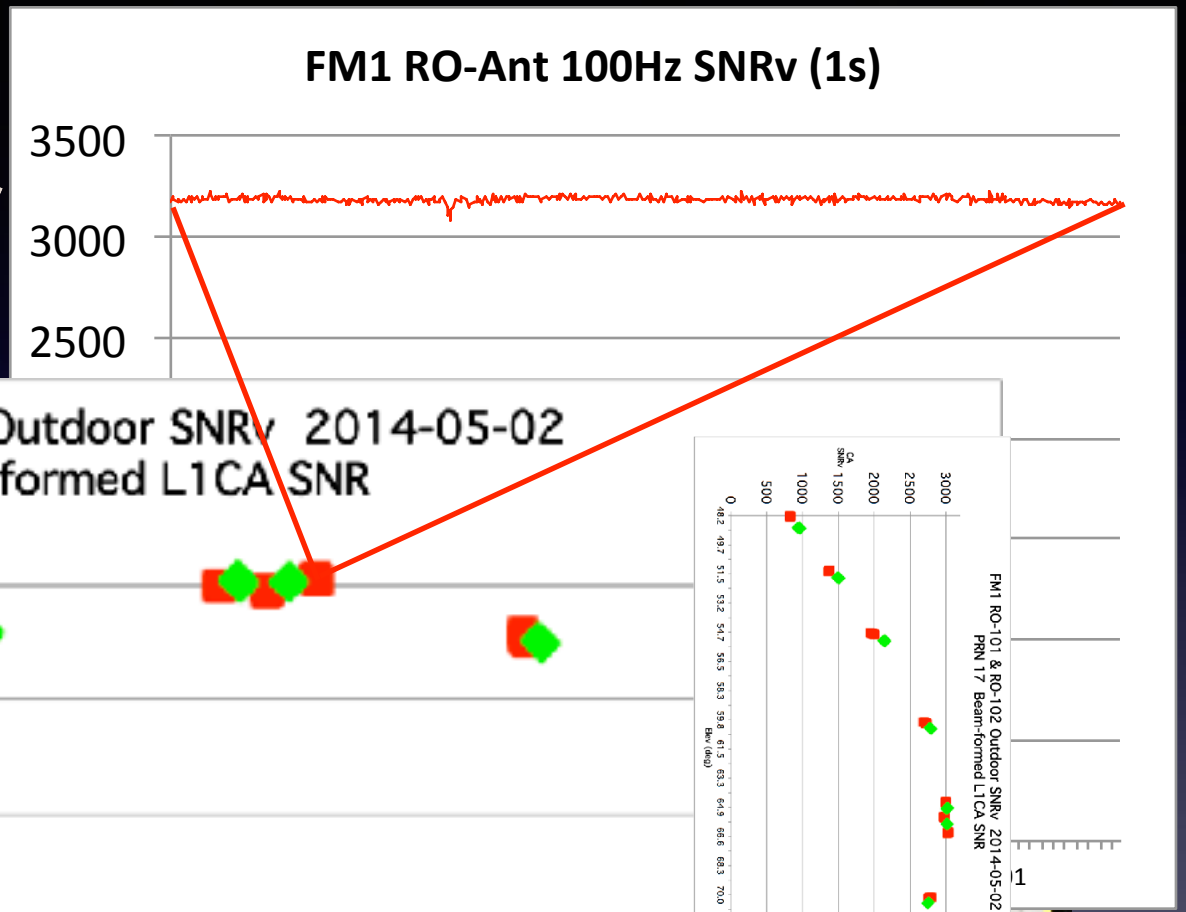


TGRS / C-2 Key Requirements

L5-SW-002	The TGRS software (SW) shall provide navigation data with 0.1 Hz cadence to the Spacecraft Bus through a RS-422 interface with data rate of 115 kbps
L5-SW-003	The TGRS SW shall provide neutral atmosphere soundings of 1100/day.
L5-SW-005	The TGRS SW shall provide occultation limb soundings of 1015/day
L5-SW-007	The TGRS SW shall provide State of Health telemetry to the Spacecraft through an RS-422 serial bus UART interface
L5-SW-010	The TGRS SW shall be capable of accepting an update to the NAV DSP and Science DSP FPGAs.
L5-SW-015	The TGRS SW shall implement open loop recording on L1 and L2 when making RO neutral atmosphere measurements below a settable altitude.
L5-SW-016	The TGRS SW shall have the ability to collect ionospheric phase and amplitude data at 1 or 50 Hz based on altitude of the line-of-sight tangent point or as commanded.
L5-SW-020	The TGRS SW shall track GPS/GLONASS FDMA satellites with less than 1 phase break per 10 occultations when the 1 sec SNRv is above 200
L5-SW-023	The TGRS SW shall be capable of tracking 18 occultation signals simultaneously from a mixture of GPS and GLONASS FDMA satellites.
L5-SW-026	The TGRS SW shall be capable of digitally steering each beam of each RO antenna (total of 3 beams per RO antenna and 2 RO antennas)
L5-SW-031	The TGRS SW shall have the ability to collect occultation phase and amplitude data of 50 or 100 Hz based on altitude of the line-of-sight tangent point or as commanded.
L5-SW-032	Line-of-sight tangent point heights for which atmospheric occultation data are collected shall be configurable from 200 km to -400 km at 10 km intervals.
L5-SW-033	The TGRS SW shall be capable of updating FPGA firmware, and user processor software on orbit
L5-SW-037	The TGRS SW navigation processor shall track at least 16 dual frequency channels simultaneously with at least 7 channels dedicated to top-side arcs
L5-SW-038	The TGRS SW navigation processor shall track at least 16 dual frequency channels simultaneously with at least 9 channels dedicated to ionosphere occultations

TGRS / C-2 Beamforming



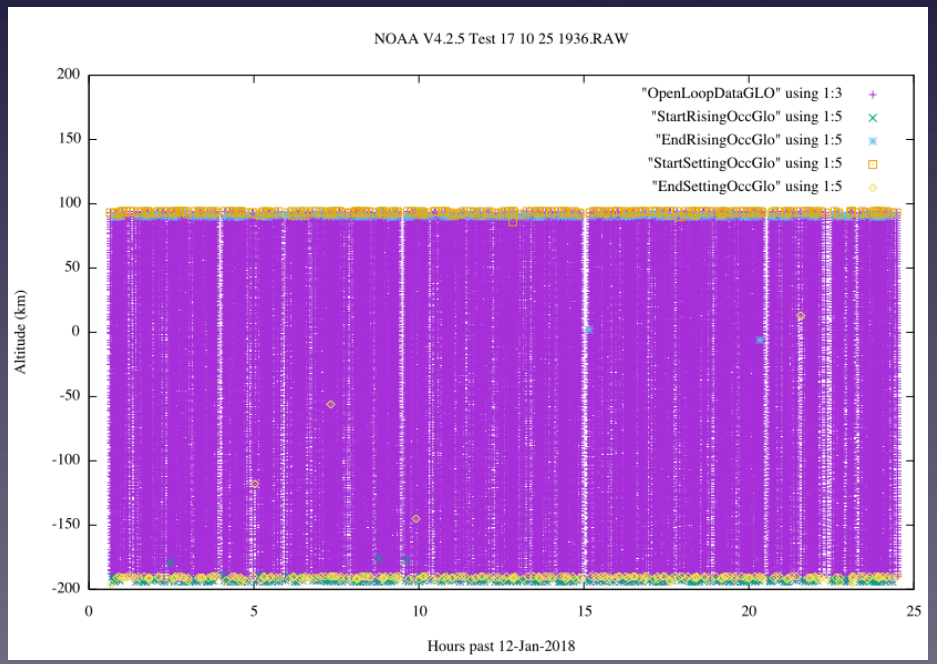


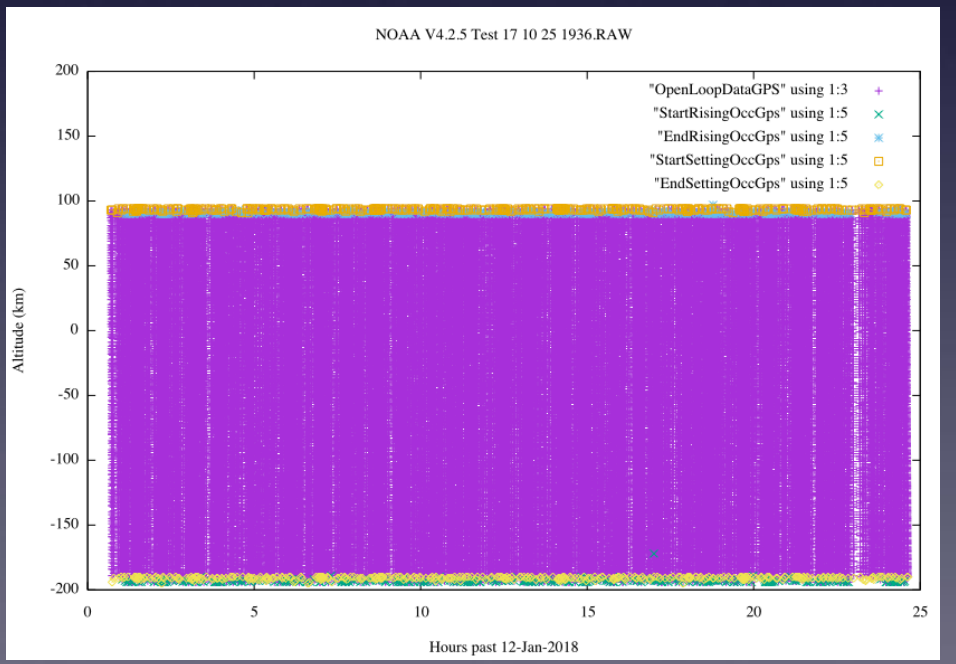
TGRS / C-2 Neutral Atmo Occs

L4-TGRS-061: The number of TGRS instrument tropospheric RO soundings per day per payload shall be 1100/day (GPS and GLONASS combined).
L4-TGRS-069: TGRS instrument shall track rising and setting tropospheric RO in open loop mode with up to two signals, L1CA and L2C or L2P starting at a settable LOS-TP

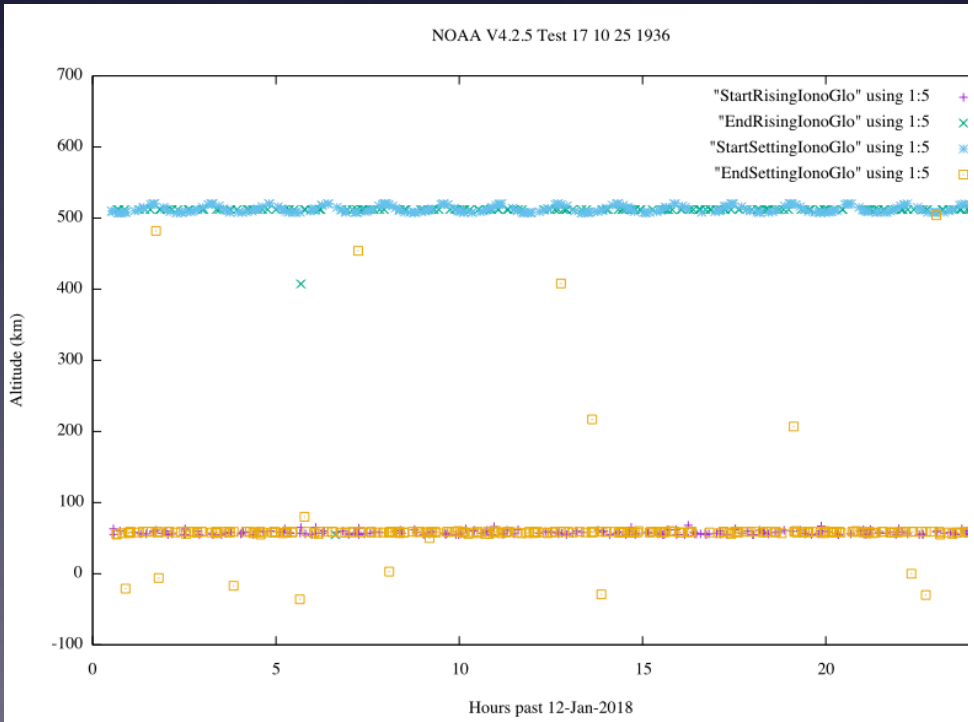
Test: Normal Simulator Signal Tracking for 24 hours

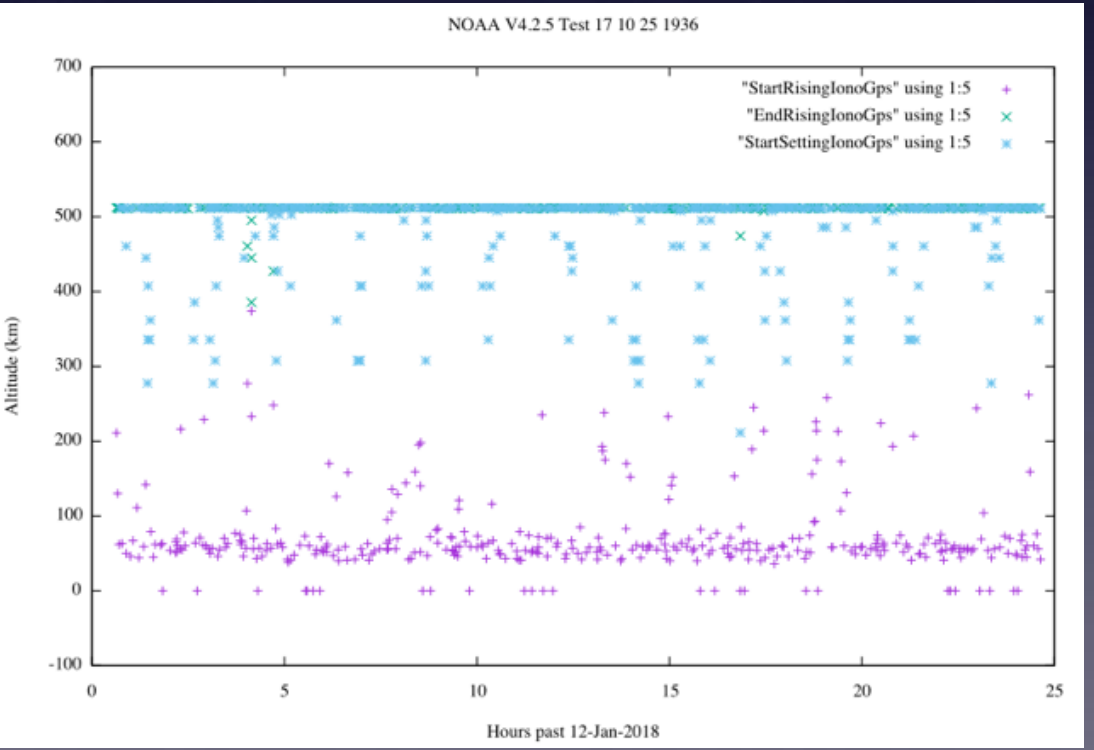
In this test, there are a total of 1185 RO soundings, with 480 from GLONASS and 705 from GPS. Of the 1185 RO soundings, 578 were rising and 607 were setting.



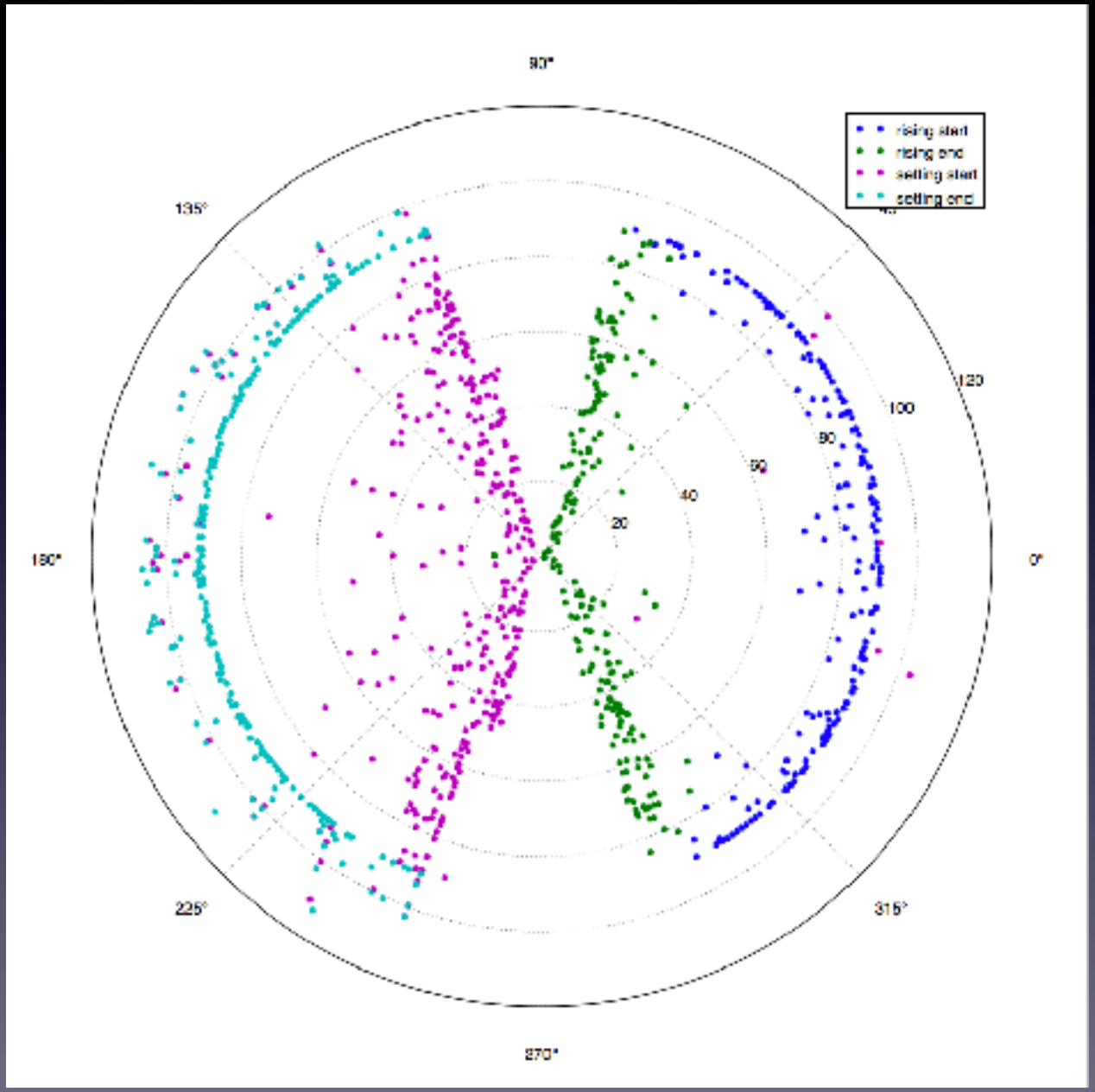


TGRS / C-2 Ionospheric Occs

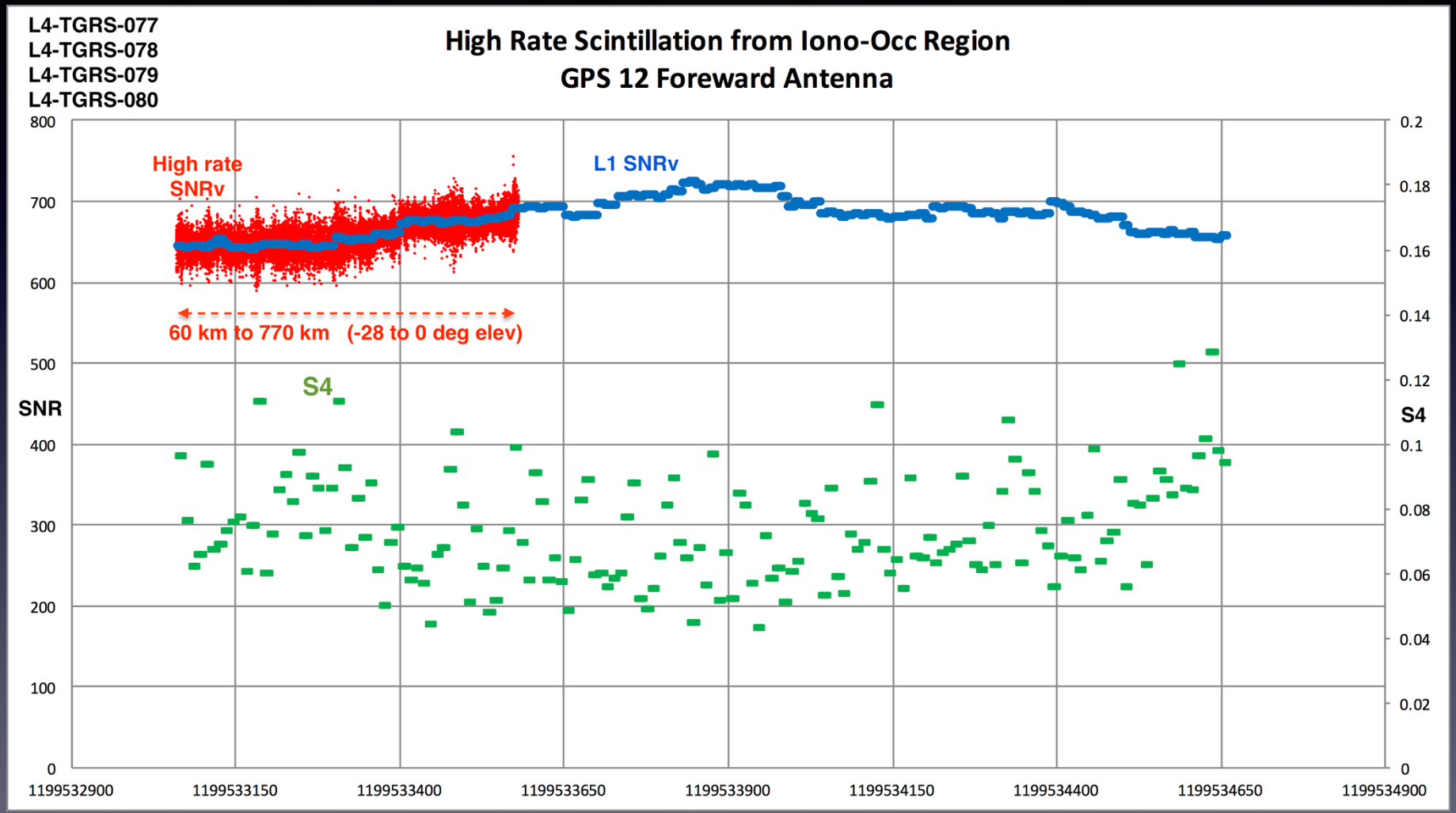




TGRS / C-2 Ionospheric Arcs



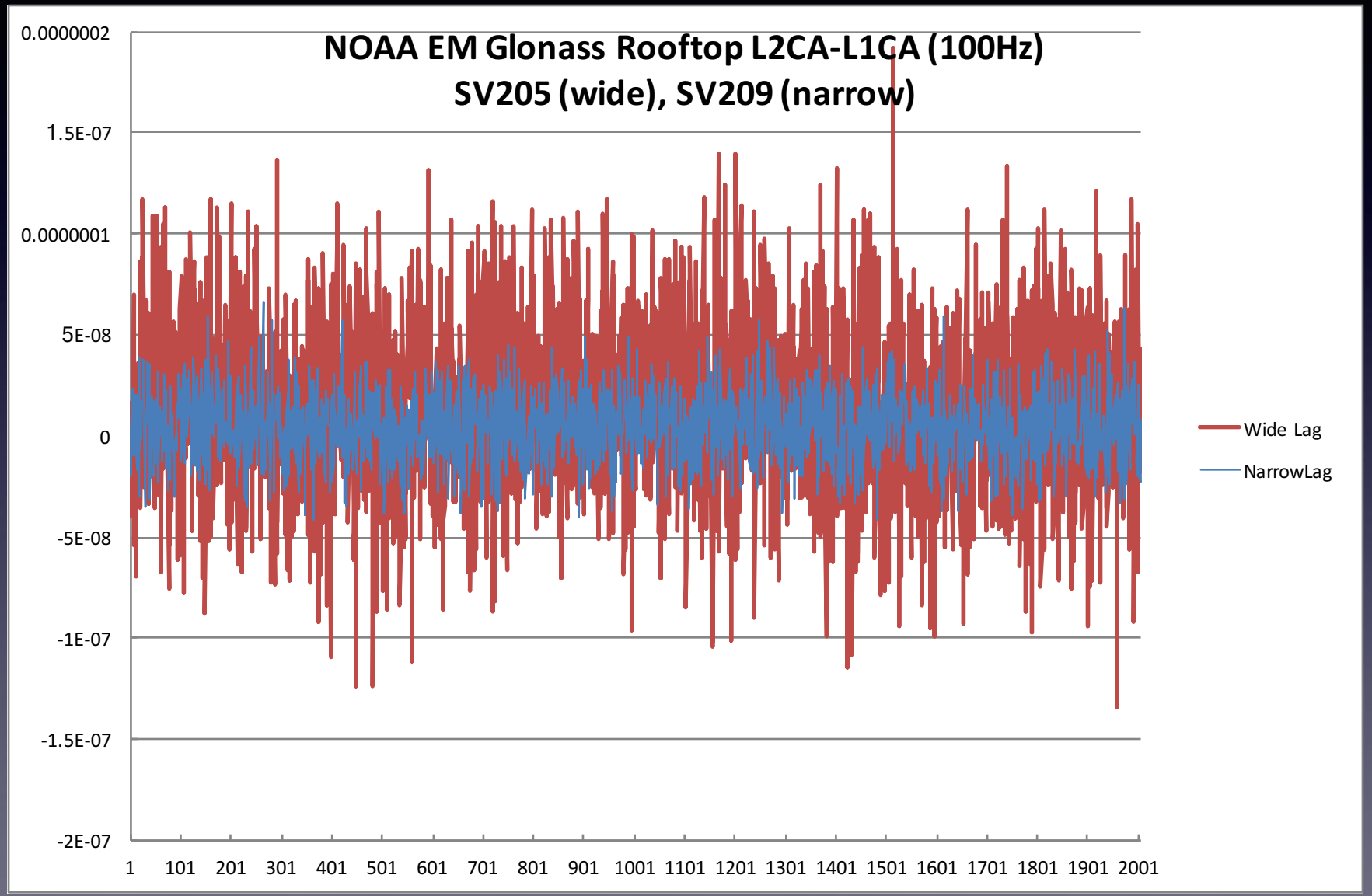
TGRS / C-2 Scintillation



Summary

- TGRS Flight Software Version 4.2 has been shown to meet L4 requirements
- JPL plans to make some script file changes during ATLO testing to improve diagnostics and configure final flight parameters
- Increasing the number of Iono and Atmo profiles is feasible with post-launch SW modifications

TGRS / C-2 Path Forward



Path Forward
Ionospheric Arcs & Occs Improvements

- If required, it's possible to improve the beginning and ending altitudes of the ionospheric occultations. For GPS it may require some trade-offs with POD scheduling.
- Increasing the number of GPS occultations may be possible by either handing some GPS occultations over to SciP or by increasing the number of channels the SW can simultaneously process. Current limit is 16 but HW has capability for 18.
- Some increase in Ionospheric and Atmospheric profile count can also be achieved by adding the Galileo constellation to the SciP processing.

TGRS / C-2 Ionospheric Arcs

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